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Guide to Concrete Repair Second Edition Prepared by: Kurt F. von Fay, Civil Engineer Technical Service Center August 2015 The mission of the Bureau of Reclamation is to manage, develop, protect water and related resources in an environmentally and economically sound manner. The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, supplies energy to power our future. This edition's success is owed to the combined efforts of numerous individuals who contributed their time and expertise. The original author, W. Glenn Smoak, laid the groundwork for this updated guide. Many researchers and field workers were instrumental in providing valuable information through their research and hard work. These contributors include Kurt D. Mitchell, Richard Pepin, Gregg Day, Jim Bowen, Dr. Alexander Vaysburd, Dr. Benoit Bissonnette, Maxim Morency, Brandon Poos, Westin Joy, David Starbuck, Dr. Matthew Klein, and John Robertson. A special thank you is extended to Dr. William F. Kepler for securing the necessary funding to prepare this updated guide. Nancy Arthur provided invaluable assistance by thoroughly reviewing and editing the specifications sections, ensuring they accurately represented the intended meaning. Teri Manross deserves recognition for her dedication in reviewing, editing, and formatting the Guide. The authors are also grateful to numerous others who provided essential support throughout the process. A report from the National Cooperative Highway Research Program titled "Underwater Inspection and Repair of Bridge Substructures" was released in June 1982. This synthesis of highway practice was a collaborative effort by various institutions, including the Mail Transportation Research Board and the Transportation Research Board. The executive committee for this project included prominent figures such as Thomas D. Larson, who served as chairman; Darrell V. Manning, the director of Idaho's Transportation Department; and Thomas B. Deen, the executive director of the Transportation Research Board. Other notable members of the committee included Ray A. Barnhart, the Federal Highway Administrator; Robert W. Blanchette, the Federal Railroad Administrator; and Francis B. Francois, the Executive Director of the American Association of State Highway and Transportation Officials. The report's purpose was to provide guidance on safe procedures for underwater inspection and repair of bridge substructures. This text is about a publication titled "Guidelines for Vertical Concrete Formwork" prepared by the Scaffolding, Shoring & Forming Institute. The institute welcomes comments and suggestions on this document. The guidelines cover introduction, general information, erection of formwork, bracing, walkways/scaffold brackets, special applications, inspection, concrete placing, and the effect of formwork removal time reduction on construction productivity. Using a specific concrete mix, known as C24 with a characteristic value of 24 MPa, an experiment was conducted. The study materials included ordinary Portland cement (OPC), high fineness and SO3 OPC (HFS_OPC), and Early Portland cement (EPC). The unit weights of the cements were set to 330, 350, and 380 for OPC. Additionally, a concrete mixture was prepared with a triethanolamine (TEA)-based chemical admixture to HFS. A raw material analysis was conducted, examining the compressive strength, temperature history, maturity (Dh), and vertical formwork removal time according to each country's criterion. Concrete is composed of two primary components: aggregates and paste. Aggregates make up 60-80% of the volume, while the paste, comprising cement, water, and entrained air, occupies 20-40%. A well-graded aggregate with low void content is desired for efficient use of paste. Each particle is fully coated with paste, and the space between particles is filled with paste. The quality of concrete relies heavily on the quality of the paste, influenced by the ratio of water to cement and curing extent. The hydration reaction between cement and water takes place rapidly initially and more slowly over time in favorable moisture conditions. Excess water is used to make the concrete workable; however, this reduces its strength and weather resistance. A proper proportion of water to cement is essential for quality concrete. Report on the Influence of Input Materials on the Quality of Architectural Concrete by Veronika Ondryášová Faculty of Civil Engineering, Brno University of Technology, 2018 Approved For Public Release; Distribution Unlimited This report explores the impact of input material properties on the quality of architectural concrete surfaces. The introduction defines architectural concrete and its advantages and disadvantages. Subsequent chapters discuss characteristics, dosage, and chemical composition of input materials. A crucial factor in creating a high-quality surface is the development of a suitable recipe, followed by proper compaction, precise placement in molds, and subsequent surface treatment. Various types of architectural concretes are described, including their production methods. The report also examines the influence of input material properties on the quality of these concretes. This diploma thesis explores the influence of feedstock properties on the quality surfaces of architectural concrete. The introduction defines architectural concrete, its advantages, and disadvantages. The practical part proposes four recipes that modify the type or dosage of input materials, prioritizing minimal segregation of fresh concrete and minimizing pore formation on hardened concrete. Key words: Architectural concrete, feedstocks, formwork, separation means, cement, additives, pigment. This diploma thesis delves into the impact of feedstock properties on architectural concrete surfaces. The introduction defines architectural concrete, its benefits, and drawbacks. The chapters that follow detail the characteristics, dosage, or chemical composition of input materials. In addition to mixture design, crucial factors for a quality surface include compaction, precise placement in formwork, and subsequent surface treatment. Early-Age Cracking in Concrete: Causes, Consequences, Remedial Measures, and Recommendations applied sciences Review Early-Age Cracking in Concrete: Causes, Consequences, Remedial Measures, and Recommendations Md. Safiuddin 1,*, A. B. M. Amrul Kaish 2 , Chin- Ong Woon 3 and Sudharshan N. Raman 3,4,* 1 Angelo DelZotto School of Construction Management, George Brown College, 146 Kendal Avenue, Toronto, ON M5T 2T9, Canada 2 Department of Civil Engineering, Infrastructure University Kuala Lumpur, 43000 Kajang, Selangor, Malaysia; 3 Centre for Innovative Architecture and Built Environment (SErAMBI), Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia; 4 Smart and Sustainable Township Research Centre (SUTRA), Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia * Correspondence: msafi (M. S.); (S. N. R.) Received: 15 July 2018; Accepted: 28 August 2018; Published: 25 September 2018 Abstract: Cracking is a common problem in concrete structures in real-life service conditions. In fact, crack-free concrete structures are very rare to find in the real world. Concrete can undergo early-age cracking depending on mix composition, exposure environment, hydration rate, and curing conditions. Understanding the causes and consequences of cracking thoroughly is essential for selecting proper measures Effective Remedial Measures for Early-Age Cracking in Concrete ========== Early-age cracking in concrete poses significant problems for construction projects. This paper aims to identify the major causes and consequences of early-age cracking, and provide effective remedial measures to reduce or eliminate this issue. Types of Early-Age Cracks, Causes, and Remedies ---------- * Different types of early-age cracks are discussed, including their factors affecting initiation and growth. * The paper explores the various causes of early-age cracking in concrete, including the impact on construction projects. * Effective remedial measures are proposed to address early-age cracking issues. Underwater Concrete Placement in Drilled Shafts ---------- Construction of drilled shafts underwater requires high-quality concrete placement techniques. However, problems have occurred due to improper concrete mix or procedures. The paper discusses key technical issues in concrete mix design, production, and placement for successful drilled shaft construction. Two case histories from lesson-learned projects are also presented. Technical Issues in Underwater Concrete Construction ---------- * Cement washout, laitance, segregation, cold joints, and water entrapment are discussed as critical factors affecting underwater concrete placement. * The paper emphasizes the importance of unique properties in concrete for successful underwater construction. High-rise building construction involves a range of complex processes, and understanding the specific requirements for design and materials is crucial. This section delves into the factors influencing formwork, including high wall formworks, timber framed formworks, sheathing techniques, and various systems for tying walls together. The selection of suitable formwork depends on several factors, such as the building's height and architectural design. Different methods are employed to ensure stability and support during the construction process. Among these techniques are: * High wall formworks * Timber framed formworks * Sheathing methods * Wall tying systems Additionally, specific considerations must be made for managing joints within these structures and utilizing forms that can climb or jump up walls.